EXPLANATION OF SIGNIFICANT DIFFERENCES:

TECHNICAL IMPRACTICABILITY WAIVER OF GROUND WATER CLEANUP STANDARDS

G.E./MOREAU SUPERFUND SITE

SARATOGA COUNTY, NEW YORK

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Region II

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Date

INTRODUCTION

The United States Environmental Protection Agency ("EPA") announces that it has prepared this Explanation of Significant Differences ("ESD") to the 1987 Record of Decision ("ROD") for the G.E./Moreau Site (the "Site"), Saratoga County, New York. The ESD documents EPA's decision to waive applicable or relevant and appropriate requirements ("ARARs") for ground water cleanup at the Site based on the technical impracticability, from an engineering perspective, of restoring contaminated ground water at the Site within a reasonable time frame.[1]

In making its determination to issue the waiver, EPA considered scientific developments in the field of aquifer restoration since issuance of the ROD in 1987, site-specific hydrogeologic and contaminant-related information, and ground water modeling of contaminant transport through the Moreau aquifer. As a result of its evaluation, EPA estimates that cleanup of the ground water at the Site may take 200 years or more, regardless of the remedial method employed, rather than decades as stated in the 1987 ROD. The long restoration time frame is the result of hydrogeologic and contaminant-related factors that limit the effectiveness of ground water remediation at the Site. In light of these constraints, EPA has determined that it is technically impracticable to attain cleanup standards for contaminants in the ground water at the Site and is waiving the cleanup standards for these contaminants pursuant to Section 121(d)(4)(C) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended ("CERCLA"), and §300.430(f)(1)(ii)(C)(3) of the NCP.

This modification does not alter the method of handling hazardous substances selected by EPA in its 1987 ROD. Specifically, this waiver does not relieve the General Electric Company ("GE") of its continuing obligation to implement the 1987 ROD, which required utilization and maintenance of the soil-bentonite cutoff wall and cap (the "containment system") that surrounds the former industrial disposal area; monitoring of ground water levels and quality in wells; treatment by air stripping of the plume where it exits at Reardon Brook, until surface water cleanup standards in the 1987 ROD (i.e., drinking water standards or New York State Ambient Water Quality Standards and Guidance Values) have been met; placement of contaminated soil within the disposal area; and

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[1] The Preamble to the National Oil and Hazardous Substances Pollution Contingency Plan (the "NCP") states (p. 8732), "Reasonable restoration time periods may range from very rapid (one to five years) to relatively extended (perhaps several decades)." EPA's Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites, December 1988, states (p. 5-8), "...a waiver may not be necessary if cleanup levels will be achieved in a reasonable time frame (i.e., less than 100 years)."

extension of the Village of South Glens Falls public water supply system to provide a permanent public water supply for approximately 100 residences determined by EPA to be affected or potentially affected by the ground water plume. All components of the remedy specified in the ROD have been implemented.

EPA has provided the public with notice of this ESD in accordance with Section 117(c) of CERCLA and announced the opportunity for the public to submit written and oral comments on the ESD and supporting documents. In November 1990, EPA initiated a separate comment period on documents used in the evaluation of the possible need to waive ARARs. The public notice announcing the draft ESD also announced the merger of these two public comment periods into one 30-day public comment period. Details regarding the public participation activities are provided below.

SUMMARY OF SITE HISTORY, SITE CONTAMINATION, AND SELECTED REMEDY

From 1958 to 1968, the Site was used as an industrial waste disposal site. An evaporative pit at the Site received approximately 452 tons of waste material generated by GE. The waste material included trichloroethylene ("TCE"), polychlorinated biphenyls ("PCBs"), spent solvents, oils, sludge, and other miscellaneous waste.

The Site was proposed for inclusion on the National Priorities List of Superfund sites in December 1982. In 1983, EPA and GE entered into an Administrative Order on Consent (Index No. II CERCLA-30201), in which GE agreed to, among other things, a) conduct a remedial investigation/feasibility study ("RI/FS"), b) design and construct the EPA-selected remedy, and c) conduct post-remediation monitoring and operation and maintenance of the Site. The RI Report identified a plume of volatile organic contaminants ("VOCs"), primarily TCE, emanating from the disposal pit area. The ground water plume is approximately 4800 feet long and about 2000 feet at its widest point. Contamination was also detected in Reardon Brook, where the ground water discharges to surface water.

Following the close of the public comment period on the proposed remedial action plan, EPA issued its ROD on July 13, 1987. The components of the selected remedy that relate to aquifer restoration are as follows:

* utilization of the soil-bentonite cutoff wall around the former disposal area to contain the source of ground water contamination;

* continued monitoring of 18 downgradient wells to ensure that the slurry wall is containing the source of

ground water contamination and monitoring of 29[2] wells to determine if changes are occurring in the size and direction of the plume;

* continued treatment of the plume where it exits at Reardon Brook (i.e., natural gradient flushing and treatment of the contaminated ground water); and

* utilization of the air stripping system to remove volatile organic compounds from Reardon Brook.

Other components of the selected remedy include:

* removal of PCB-contaminated soil adjacent to the disposal area and placement of these soils within the slurry wall;

* provision of a public water supply system to approximately 100 residences affected or potentially affected by the plume of contaminated ground water; and

* review of the remedial action no less than each 5 years after the initiation of such action to assure that human health and the environment are being protected by the remedial action and performance of additional action deemed appropriate based on this review.

In addition, in the 1987 ROD, EPA recommended that the Town of Moreau establish institutional controls for restricting the withdrawal of ground water from within the ground water plume. The Town of Moreau has not established such institutional controls and EPA continues to support its 1987 recommendation.

DESCRIPTION OF SIGNIFICANT DIFFERENCES AND THE BASIS FOR THOSE DIFFERENCES

The significant difference from the 1987 ROD outlined herein is a result of EPA's review of scientific developments since issuance of the 1987 ROD, site-specific hydrogeologic and contaminant-related information, and ground water modeling of contaminant transport within the Moreau aquifer at the Site. Based on its review, EPA estimates that the time frame for aquifer restoration may be 200 years or more regardless of the remedial method employed, rather than decades as specified in the ROD. The long restoration time frame is the result of hydrogeologic and contaminant-related factors that limit the effectiveness of

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[2]The number of monitoring wells was increased from 29 to 33 to reflect the fact that well locations DGC-20 and DGC 21 are 3-well clusters rather than single wells.

ground water remediation at the Site. In light of these constraints, EPA has determined that it is technically impracticable from an engineering perspective to restore the ground water at the Site within a reasonable time frame and is issuing a waiver of the Site ground water ARARs.

Evaluation of Technical Impracticability

For the G.E./Moreau Site, the technologies that can feasibly remediate the contaminated ground water include various pumping alternatives with treatment, of which pulsed pumping is the most efficient; and natural gradient flushing with treatment. Pulsed pumping and treatment is an innovative technique in which extraction wells are periodically turned on and off in an effort to increase the concentration of contaminants in the extracted ground water, thereby increasing the efficiency of the pump-and-treat system. Ground water treatment occurs at the surface by air stripping. The natural gradient flushing with treatment method of remediating ground water occurs under natural gradient (non-pumping) conditions. Contaminants in ground water move through the aquifer in response to the natural hydraulic gradient of the aquifer system. Contaminated ground water is treated where it discharges to the surface by methods similar to those used with pumping systems.

Estimates of the time frame for ground water restoration and the number of pore volumes to be replaced were used together to evaluate the efficiency of various remedial actions capable of restoring ground water. The time frame for aquifer restoration is the period of time required to achieve cleanup levels in the ground water within the contaminant plume. A pore volume is the total volume of ground water present in the pore spaces between aquifer particles at any one time. At the Site, one pore volume is equal to approximately 1.29 billion gallons.

Recent developments in the field of ground water remediation, based on laboratory and field scale demonstrations and case studies of sites, have led to the identification of hydrogeologic and contaminant-related factors that are responsible for increased time frames for aquifer cleanup. These factors are variations in hydraulic conductivity, variations in sorption capacity of the aquifer material, and desorption nonequilibrium. These factors are in effect at the Site and are expected to significantly increase aquifer cleanup time beyond the time frame estimated in the ROD, for both pumping and natural flushing remediation processes.

As part of its evaluation, EPA modeled remediation of contaminated ground water at the Site under natural gradient and pumping conditions. The computer model employed represents an advance in contaminant transport modeling because it incorporates

the factors identified above, i.e. variations in hydraulic conductivity, variations in sorption capacity of the aquifer material, and desorption nonequilibrium, to provide more accurate estimates of aquifer restoration time frames than previously available.

Site-specific modeling of the pulsed pumping and natural gradient flushing alternatives shows that the restoration time frames are comparable (237-542 years for natural gradient flushing vs. 191-404 years for pulsed pumping), but the number of pore volumes requiring treatment is significantly different (24-55 pore volumes for natural gradient flushing vs. 88-278 pore volumes for pulsed pumping). Under the pulsed pumping alternative, an additional 80-220 billion gallons of contaminated ground water would have to be treated to attain ground water ARARs. This is attributable to the greater efficiency of the natural gradient alternative in removing contaminants from the Site compared to the pulsed pumping alternative.

The natural gradient flushing alternative is considerably more cost-effective than pulsed pumping with treatment because it removes more highly contaminated ground water and does not involve the treatment of large quantities of water or the high cost of installing, operating, and maintaining a pumping system over many years. The cost associated with pulsed pumping and treatment is estimated to be about $17 million; in contrast, the cost of the natural gradient flushing and treatment alternative is estimated to be $1.5 million when converted to a 30-year basis (ROD, pp. 15 and 22).

Waiver of Ground Water ARARs

The ROD identified the ground water cleanup levels as the Federal Maximum Contaminant Levels ("MCLs") and, absent an MCL for a particular contaminant, the New York State Ambient Water Quality Standards and Guidance Value ("NYSAWQS"). Thus, the ground water ARARs for site-related VOCs are:

Federal MCLs:
5 ppb for TCE
2 ppb for vinyl chloride
7 ppb for 1,1-DCE
100 ppb for total trihalomethanes (includes chloroform and dichlorobromomethane detected at the Site)

NYSAWQS:
50 ppb for trans-1,2-dichloroethylene
50 ppb for methylene chloride

In accordance with Section 121(d)(4)(C) of CERCLA, EPA may select a remedial action that does not attain an ARAR if compliance with

the ARAR is technically impracticable from an engineering perspective. When it issued the ROD in 1987, EPA did not issue a waiver of these ARARs because it believed that ground water ARARs would be attained within a time period of decades (see ROD, p. 21). However, in September 1989, the United States District Court for the Northern District of New York found that EPA had waived compliance with New York State's ARARs. It was thereafter agreed that EPA would undertake a reevaluation of the aquifer restoration component of the remedy. EPA's reevaluation indicates that the ARARs listed above may not be attainable for 200 years or more, because of hydrogeologic and contaminant-related factors that limit the effectiveness of ground water remediation at the Site. Therefore, EPA is waiving ARARs for the contaminants listed above based on the technical impracticability of attaining these ARARs.

In cases where it is not practicable to return usable ground water to its beneficial uses within a time frame that is reasonable given the particular circumstances of a site, EPA expects to a) prevent further migration of the plume, b) prevent exposure to the contaminated ground water, and c) evaluate further risk reduction (40 C.F.R. § 300.430(a)(1)(iii)(F). Because it is not practicable to return the ground water at the Site to its beneficial use within a reasonable time frame, EPA acknowledges a loss of the beneficial use of the ground water at the Site for such time period as contaminant levels remain above the ARARs being waived herein, which is estimated to be 200 years or more regardless of the remedial method employed.

With respect to preventing plume migration, EPA's 1987 ROD requires monitoring ground water on a semi-annual basis to detect any changes in the size or direction of the plume. To date, these data indicate no such changes in the plume. With respect to preventing exposure to the contaminated ground water, GE has provided a permanent public water supply for the approximately 100 residences determined by EPA to be affected and potentially affected by the ground water plume, as required by the 1987 ROD. Moreover, a February 24, 1993 Site Review and Update performed by the Agency for Toxic Substances and Disease Registry ("ATSDR") states that ATSDR and the New York State Department of Health believe that no significant exposure to Site contaminants is currently occurring. Although EPA believes that no further risk reduction is necessary at the Site beyond the continued operation and maintenance of the ROD remedy[3], it continues to recommend that the Town of Moreau establish institutional controls for

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[3] In a separate ESD, EPA required a modification of the ROD remedy to improve its performance. Specifically, EPA is requiring that the containment system surrounding the former industrial waste disposal area be enhanced to reduce exfiltration by creating an inward hydraulic gradient.

restricting the withdrawal of ground water within the plume area, as stated in the 1987 ROD.

SUPPORT AGENCY COMMENTS

In its January 5, 1994 letter to EPA, the New York State Department of Environmental Conservation ("NYSDEC") provided the following support agency comments:

> "NYSDEC has been consulted during EPA's review of this matter, including review of the documents added to the administrative record file concerning EPA's waiver determination. NYSDEC acknowledges the applicability of 40 CFR §300.430(f)(ii)(C)(3) regarding the technical impracticability of pulsed pumping with treatment, for the restoration objectives in this case, but it has not independently confirmed the data nor the analyses undertaken to reach that determination. NYSDEC has reviewed the administrative record as it exists and acknowledges EPA's determination on that basis."

AFFIRMATION OF THE STATUTORY DETERMINATIONS

Upon completion of the reevaluation, EPA believes that the selected remedy for ground water restoration at the Site remains protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to this remedial action where possible, and is cost-effective. In addition, the ground water remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for the Site.

PUBLIC PARTICIPATION ACTIVITIES

This ESD and the public notice announcing the ESD, as well as detailed information in support of the ESD, are available in the administrative record file for the Site. These documents are available for public inspection at the information repositories, located at the Crandall Library, Glen Street, Glens Falls, New York 12801 (518) 792-6508; at the Ft. Edward Free Library, 23 East Street, Fort Edward, New York, 12902 (518) 747-6743; and at the Moreau Town Hall, 51 Hudson Street, South Glens Falls, New York 12801 (518) 792-1030. The file may also be reviewed at EPA's Region II office, located at 26 Federal Plaza, Room 747, New York, New York 10278, by contacting the Project Manager, Ms. Alison Hess, at (212) 264-6040.

The public comment period for this ESD was limited to EPA's determination to waive ground water cleanup standards based on the technical impracticability of attaining those standards and on the documents identified by EPA that form the basis for its determination. The 30-day public comment period began on

February 26, 1994. At the request of the Town of Moreau, EPA extended the public comment period for an additional 30 days, or until April 27, 1994. Notice of the extension was published by EPA on April 7, 1994.

A public meeting was held during the public comment period at the Washington County Office building, Board of Supervisors Chambers, Upper Broadway, in Ft. Edward, New York on March 1, 1994 at 7:30 p.m. At the meeting, EPA presented information on the ARAR waiver and received public comment.

All comments submitted during the public comment period that were responsive to EPA's request and EPA's responsiveness summary have been placed in the administrative record file for the Site.

Attachment to Explanation of Significant Differences
for
G.E./Moreau Superfund Site

Technical Memorandum: Summary of Supporting Information
for ARAR Waiver Based on Technical Impracticability

Technical Impracticability Evaluation

1. Specific ARARs: The July 13, 1987 ROD identified the ground water cleanup levels as the Federal Maximum Contaminant Levels ("MCLs") and, absent an MCL for a particular contaminant, the New York State Ambient Water Quality Standards and Guidance Value ("NYSAWQS"). Thus, the ground water ARARs for site-related VOCs are:

Federal MCLs:
5 ppb for TCE
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7 ppb for 1,1-DCE
100 ppb for total trihalomethanes, which include chloroform and dichlorobromomethane detected at the Site

NYSAWQS:
50 ppb for trans-1,2-dichloroethylene
50 ppb for methylene chloride

2. Spatial Area over which TI waiver will apply: The TI waiver will apply to the entire ground water plume area, which is approximately 4800 feet long and about 2000 feet at its widest point. The average depth of the Moreau aquifer in the area of the plume is 60 feet.

3. Site Conceptual Model: The Site conceptual model is described in Hess et al. (1993). This conceptual model includes information on the geology and hydrology, information of the source and release of contamination, and parameters related to the distribution, transport, and fate of contaminants at the Site.

Hydrogeological Constraints: The primary hydrogeological constraint is the high degree of variability in hydraulic conductivity across the Moreau aquifer. This is due to the heterogeneity of the aquifer material; 75% of the aquifer material ranges from coarse sand to fine sand with occasional silt and clay lenses; the remaining 25% of the aquifer consists of interbedded fine sand, silt, and clay seams.

Significant factors include:

a) Geology

stratigraphy	interbedded strata
texture	sand, silt, clay

b) Hydraulics/Flow
hydraulic conductivity variable, Site data from 10^{-2} to 10^{-3} cm/sec

c) Media Properties

deg. heterogeneity	high degree
deg. isotropy	anisotropic
contaminant R pot.	assumed range low to moderate (R=1,3 in glaciodeltaic unit; 3,6 in upper glaciolacustrine unit). Mackay et al. (1985) gave a range of retardation factors from 1 to 10 for sand and gravel aquifers with low organic content.

Contaminant-related Constraints: Contaminant-related constraints include the nature of the release, the chemical properties of the TCE, and the contaminant distribution:

a) Nature of Release

large volume	452 tons of mixed waste
long duration	10 year period, 1958-1968

b) Physical and Chemical Properties: TCE is a halogenated aliphatic organic compound used as an ingredient in industrial cleaning solutions and as a degreasing agent. The following physical and chemical properties are directly responsible for behavior, transport, and fate of TCE in the environment.

Melting point: low, -87°C. The melting point of a compound provides an indication of the physical state of a pure compound at field temperatures. Compounds with melting points lower than 30°C, such as TCE, may be present as a mobile nonaqueous phase liquid.

Density: high, 1.46 g/ml. The density of a compound indicates whether the compound is heavier or lighter than water (the density of water is 1.0 g/ml).

Dynamic viscosity: low, 0.570 cp. Dynamic viscosity provides an indication of the ease with which a compound, in its pure form, will flow. The mobility of the compound in pure form is inversely proportional to its dynamic viscosity. The dynamic viscosity of water is approximately 1.0 centipoise (cp).

Kinematic viscosity: low, 0.390 cs. The kinematic viscosity of a compound takes into account the density of the compound and provides an indication of the ease with which the compound, in its pure form, will percolate through the subsurface. The lower the kinematic viscosity of a compound, the greater will be

its tendency to migrate in a downward direction. The kinematic viscosity of water is approximately 1.0 centistokes (cs).

Water solubility: high, 1000 mg/l at 20°C; 1100 mg/l at 25°C. Water solubility governs the extent to which a contaminant will partition into the aqueous phase.

Log K_{ow}: low, 2.10. The octanol/water partition coefficient is a measure of the extent to which a contaminant partitions between octanol and water. It is the ratio of the concentration of the compound in octanol to the concentration of the compound in water. The K_{ow} provides an indication of the extent to which a compound will adsorb to a soil or an aquifer solid, particularly organic material. The greater the K_{ow} value of a compound, the greater will be its tendency to be adsorbed in the subsurface.

Log K_{oc}: low, 2.42. The organic carbon partition coefficient is the ratio of the amount of contaminant adsorbed per unit weight of organic carbon in the soil to the concentration of the contaminant in solution at equilibrium. The K_{oc} is similar to the K_{ow}; these are used to calculate the retardation factor.

Potential Subsurface Mobility: moderate ($2.2 < \text{Log } K_{oc} \geq 3.2$)

Henry's Law Constant: high, 8.92 E-03 atm-m^3/mol. Henry's Law provides a indication of the extent to which a compound will volatilize from an aqueous solution. Henry's Law Constant is directly proportional to the vapor pressure of the compound and inversely proportional to the water solubility of the compound. The Henry's Law Constant for TCE is high enough, when combined with its solubility in water and high vapor pressure, for efficient transfer of TCE to the atmosphere (e.g., treatment by air stripping).
Vapor Pressure: high, 5.87 E+01 mm Hg. The vapor pressure of a compound provides an indication of the extent to which the compound will volatilize; the tendency of a compound to volatilize will rise proportionally with its vapor pressure. For comparative purposes, the vapor pressure of water at 20°C is 17.5 mm Hg.

c) Contaminant Phases at the Site

dissolved	present, max. conc. TCE 81,000 ppb
gaseous	present, unquantified
sorbed	present, unquantified
DNAPLs	present inside the containment system possibly present outside contain. sys.

4. Degree and Effectiveness of Source Control: In 1985, General Electric Company completed construction of the containment system, which consists of a soil-bentonite slurry wall and cap. This containment system isolates all known occurrences of DNAPL contamination at the Site. In 1992, General Electric Company completed an evaluation of the performance of the containment system, as required by EPA. As a result of this evaluation, GE is designing an enhancement to the system that will reduce exfiltration, calculated at 55,000 to 65,000 gallons annually, by lowering water levels within the containment system to create an inward hydraulic gradient (see other ESD for Enhancement to Containment System).

5. Remedial Action Performance Appraisal: The current remedy has been evaluated to ensure that it is protective of human health and the environment. The remedial performance review indicates that the remedy continues to be operational and functional. A Site Review and Update performed by the ATSDR (1993, p. 7) states:

> "ATSDR and the NYDOH believe that no significant exposure to site contaminants is currently occurring."

Consistent with the requirements of the ROD, GE is monitoring water levels and concentrations in certain wells. These data document that there are no changes to the size or shape of the ground water plume.

Samples of surface water upstream of the air stripper (sampling point X-5) are collected on a quarterly and semi-annual basis as required by the ROD. Analytical data from these samples show no change in the concentration of TCE at this sampling point.

In 1989, GE conducted a special sampling and analysis of influent and effluent samples to document that the air stripper continues to reduce influent concentrations to acceptable levels. This special sampling is in addition to the periodic testing conducted by the Village of South Glens Falls to ensure acceptable water quality in its public water supply.

As mentioned above, EPA and NYSDEC have reviewed performance data for the containment system and, as a result, EPA is requiring an enhancement to the system. Following completion of the enhancement, a new performance standard will be set to ensure

that exfiltration through the slurry wall is reduced by maintaining an inward hydraulic gradient.

6. Applicability of Other Technologies: The applicability of other remedial technologies was considered. Specifically, continuous pumping, a one-time pulse followed by natural gradient flushing, pulsed pumping, air sparging, and permeable reaction wall were considered. The permeable reaction wall was eliminated due to the large size of the plume to be remediated (4800 feet long, 2000 feet at its widest, and average of 60 feet thick). Air sparging was eliminated because of the difficulty in distributing air flow throughout the heterogeneous aquifer.

All four pumping and natural gradient options were considered in the ground water flow and contaminant fate and transport modeling (Hess et al., 1993). During the modeling study, the continuous pumping and the one-time pulse were eliminated due to the relative inefficiency of these alternatives compared to natural gradient flushing and pulsed pumping.

7. Predictive Analyses: Modeling of the two remaining scenarios, natural gradient flushing and pulsed pumping, showed that restoration timeframes are comparable (237-542 years for natural gradient flushing vs. 191-404 years for pulsed pumping), but the number of pore volumes requiring treatment is significantly different (24-55 pore volumes for natural gradient vs. 88-278 pore volumes for pulsed pumping). One pore volume at the Site is approximately 1.29 billion gallons. The difference in pore volumes required is attributable to the greater efficiency of the natural gradient flushing alternative in removing contaminants from the Site compared to the pulsed pumping alternative.

8. Alternative Remedial Strategy: In cases where it is not practicable to return usable ground water to its beneficial uses within a time frame that is reasonable given the particular circumstances of a site, EPA expects to prevent further migration of the plume, prevent exposure to the contaminated ground water, and evaluate further risk reduction (NCP, § 300.430). Because it is not practicable to return the ground water at the Site to its beneficial use within a reasonable time frame, EPA acknowledges a loss of the beneficial use of the ground water at the Site for such time period as contaminant levels remain above the ARARs being waived herein, which is estimated to be 200 years or more.

With respect to preventing plume migration, EPA's ROD requires monitoring of ground water on a semi-annual basis to detect any changes in the size or direction of the plume. These data indicate no migration of the plume.

With respect to preventing exposure to the contaminated ground water, GE has provided a public water supply for residences affected and potentially affected by the ground water plume, as

required by the 1987 ROD. The ATSDR Site Review and Update (1993) states that ATSDR and the New York State Department of Health believe that no significant exposure to Site contaminants is currently occurring.

Therefore, EPA, in consultation with NYSDEC, has determined that no further risk reduction is necessary at the Site beyond the continued operation and maintenance of the ROD remedy (including the containment system enhancement described in a separate ESD). Consequently, no fundamental change to the remedial action selected in the 1987 ROD is required.[4] However, EPA continues to recommend that Town of Moreau establish institutional controls that restrict the withdrawal of ground water from within the ground water plume.

9. Cost Estimate: The cost of implementing the natural gradient flushing and treatment alternative has been estimated at $1.5 million when converted to a 30-year basis (ROD, pp. 15 and 22) for water level measurements and water quality sampling and analysis. The cost of implementing a pulsed pumping and treatment alternative is approximately $17 million, based on cost estimates obtained from the U.S. Army Corps of Engineers (1993).

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[4] In a separate ESD, EPA required enhancement to the containment system surrounding the former industrial disposal area to reduce exfiltration by creating an inward hydraulic gradient.

Index to Documents Added to the Administrative Record File in Support of this Explanation of Significant Differences

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Brusseau, M.L., 1990, Evaluation of the Efficacy of Pump and Treat Remediation of the GE/Moreau Site, July 28, 1990.

Brusseau, M.L., R.E. Jessup, and P.S.C. Rao, 1989, Modeling the transport of solutes influenced by multiprocess nonequilibrium, Water Resour. Res., vol. 25, no. 9, pp. 1971-1988.

Brusseau, M.L. and Rao, P.S.C., 1989, Sorption nonideality during organic contaminant transport in porous media, CRC Critical Reviews in Environmental Control, vol. 19, issue 1, pp. 33-99.

Brusseau, M.L., P.S.C. Rao, R.E. Jessup, and J.M. Davidson, 1989, Flow interruption: a method for investigating sorption nonequilibrium, J. Contaminant Hydrology, vol. 4, pp. 223-240.

Cross, G. and Diesl, W., 1989, Likelihood of Successful Cleanup to Drinking Water Standards (5 ppb TCE) at GE/Moreau Superfund site, Using Pump and Treat (P&T) Technology, prepared for EPA by Metcalf & Eddy, Inc., Contract No. 68-W9-0003/Subcontract No. 1-635-999-M&E, Work Assignment No. C02012.

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Diesl, W. and Cross, G., 1989, Technical basis for selection of remedial alternative in the Record of Decision (ROD) at G.E. Moreau Site, prepared for EPA by Metcalf & Eddy, Inc., Contract No. 68-W9-0003/Subcontract No. 1-635-999-M&E, Work Assignment No. C02012.

Freeze, R.A. and Cherry, J.A., 1989, What has gone wrong, Groundwater, vol. 27, no. 4, pp. 458-464.

Hess, A.A., M.L. Brusseau, and S.G. Huling, 1993. Comparison of Ground Water Restoration Methods for the G.E./Moreau Superfund Site: An Application of Nonideal Contaminant Transport Modeling, July 6, 1993.

Mackay, D.M., and Cherry, J.A., 1989, Groundwater contamination: Pump-and-treat remediation, Environ. Sci. Technol., vol. 23, no. 6, pp. 630-636.

Mackay, D.M., P.V. Roberts, and J.A. Cherry, 1985, Transport of organic contaminants in groundwater, Environ. Sci. Technol., vol. 19, no. 5, pp. 384-392.

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Brusseau, M.L., 1991a. Alternative Methods for Estimating Time Required for Aquifer Restoration, April 19, 1991.

Brusseau, M.L., 1991b, Sensitivity Analysis of Solute Transport, April 21, 1991.

Brusseau, M.L., 1992. Evaluation of the Efficacy of Pump and Treat Remediation of the GE/Moreau Site, May 19, 1992.

U.S. Environmental Protection Agency, 1991. Estimating Potential Occurrence of DNAPL at Superfund Sites, EPA Publication #9355.4-07FS, December 1991.

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Sudicky, E.A., 1986. A Natural Gradient Experiment on Solute Transport in a Sand Aquifer: Spatial Variability of Hydraulic Conductivity and Its Role in the Dispersion Process, Water Resources Research, Vol. 22, No. 13, pp. 2069-2082.

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U.S. Army Corps of Engineers, 1993. Government Estimate for G.E./Moreau Superfund Site, Saratoga County, New York, June 4, 1993.

U.S. Environmental Protection Agency, 1987, Practical limits to pump and treat technology for aquifer remediation, EPA-RSKERL.

U.S. Environmental Protection Agency, 1988, Guidance on Remedial Action for Contaminated Ground Water at Superfund Sites. EPA/540/G-88/003.

U.S. Environmental Protection Agency, 1989, Considerations in Ground Water Remediation at Superfund Sites, OSWER Directive No. 9355.4-03 (J. Cannon).

U.S. Environmental Protection Agency, 1989, Evaluation of Ground Water Extraction Remedies, Vols. 1, 2 & 3, EPA/540/2-89/054, prepared by CH2M Hill.

U.S. Environmental Protection Agency, 1989, Performance Evaluations of Pump-and-treat Remediations, EPA/540/4-89/005, Ground Water Issue Paper (J.F. Keely).

U.S. Environmental Protection Agency, 1990, Basics of Pump-and-Treat Ground-Water Remediation Technology, EPA/600/8-90/003, prepared by Geo Trans, Inc. (J.W. Mercer et al.).

U.S. Environmental Protection Agency, 1990 (draft), Basic Concepts of Organic Contaminant Sorption at Hazardous Waste Sites, EPA/540/4-90/053 Ground Water Issue Paper (M.D. Piwoni and J.W. Keeley).

U.S. Environmental Protection Agency, 1992, Evaluation of Ground Water Extraction Remedies, Phase II, Vol. 1: Summary Report; EPA Publication #9355.4-05 and 05A, February 1992.

U.S. Environmental Protection Agency, 1992, Considerations in Ground-Water Remediation at Superfund Sites and RCRA Facilities -- **Update**; EPA Directive No. 9283.1-06, May 1992.

U.S. Environmental Protection Agency, 1993, Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration, EPA Directive 9234.2-25, September 1993.

U.S. Environmental Protection Agency, 1993, Transmittal of OSWER Directive 9234.2-25: "Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration;" October 1993.

Index to Background Documents
for ESD: Technical Impracticability Waiver of
Ground Water Cleanup Standards
Added to the Administrative Record File

Letter from J. Slack of NYSDEC to D. Sommer of NYSDOL, dated May 18, 1989, regarding aquifer restoration at the Site.

Letter from J. Slack of NYSDEC to G. Pavlou of EPA, dated January 10, 1990, summarizing December 19, 1989 meeting between NYSDEC and EPA on aquifer restoration at the Site.

Letter from M. O'Toole of NYSDEC to R. Caspe of EPA, dated December 12, 1990, describing types of data needed to evaluate aquifer restoration at the Site.

Letter from G. Pavlou of EPA to S. Hammond of NYSDEC, dated January 7, 1991, summarizing December 21, 1990 meeting between NYSDEC and EPA on aquifer restoration at the Site.

Letter from K. Davis of NYSDEC to A. Hess of EPA, undated (on or about January 15, 1991), transmitting well logs, water level data, and water quality data from wells TM-6 through TM-9.

Letter from M. Ianniello of GE to A. Hess of EPA, dated February 12, 1991, indicating GE's interest in EPA's use of the ground water model developed by Dr. Brusseau of University of Arizona to predict aquifer restoration at the Site.

Letter from A. Hess of EPA to M. Ianniello of GE, dated February 15, 1991, stating EPA's plans to invite GE and the Town of Moreau to technical discussions regarding aquifer restoration at the Site.

Letter from S. Hammond of NYSDEC to G. Pavlou of EPA, dated February 15, 1991, summarizing technical discussions on aquifer restoration at the Site following the January 7, 1991 meeting between NYSDEC and EPA.

Letter from G. Pavlou of EPA to S. Hammond of NYSDEC, dated February 22, 1991, responding to NYSDEC's February 15, 1991 letter and summarizing meetings and teleconferences with technical representatives of NYSDEC, GE, the Town, Dr. Brusseau, and EPA held on January 8, January 30, and February 13, 1991.

Letter from G. Pavlou of EPA to R. Casson (consultant to the Town), S. Hammond of NYSDEC, and M. Ianniello of GE, dated March 25, 1991, summarizing a March 6, 1991 teleconference with Dr. Brusseau and technical representatives of NYSDEC, GE, and the Town.

Letter from E. (Ned) Sullivan of NYSDEC to W. Muszynski of EPA, dated April 18, 1991, summarizing April 10, 1991 meeting between technical and legal representatives of NYS and EPA.

Note to file, prepared by A. Hess of EPA, dated April 24, 1991, summarizing Dr. Brusseau's responses to GE's questions on Brusseau model.

Letter from S. Hammond of NYSDEC to G. Pavlou of EPA, dated May 3, 1991, discussing waiver of ARARs based on technical impracticability, DNAPL at the Site, and definition of aquifer to be restored.

Letter from W. Muszynski of EPA to N. Sullivan of NYSDEC, dated May 6, 1991, confirming agreements reached during April 9, 1991 meeting between technical and legal representatives of NYS and EPA.

Letter from M. Ianniello of GE to A. Hess of EPA, dated June 7, 1991, transmitting analytical results from the transition zone and horizontal hydraulic conductivity data.

Letter from E. (Ned) Sullivan of NYSDEC to W. Muszynski of EPA, dated June 12, 1991, stating that EPA's May 6, 1991 letter fairly represents the agreements reached during the April 9, 1991 meeting between technical and legal representatives of NYS and EPA.

Letter from P. Hare of GE to A. Hess of EPA, dated June 18, 1991, transmitting Table 3 of GE's June 7, 1991 letter.

Letter from K. Davis of NYSDEC to A. Hess of EPA, dated June 19, 1991, transmitting driller's logs for wells TM-1, TM-2A, TM-2, and TM-3.

Letter from A. Hess of EPA to R. Casson (consultant to Town), dated June 21, 1991, reiterating EPA's telephone request for a copy of all information that the Town has on the transition zone.

Fax from A. Hess of EPA to P. Hare of GE, dated July 2, 1991, transmitting portions of the December 1986 "Guidelines for Ground-Water Classification Under EPA Ground-Water Protection Strategy."

Letter from P. Hare of GE to A. Hess of EPA, dated July 16, 1991, regarding past and potential future use of the transition zone for water supply.

Letter from W. McCabe of EPA to S. Hammond of NYSDEC, dated August 2, 1991, summarizing technical agreements and disagreements between NYSDEC and EPA.

Letter from C. Petersen of EPA to S. Hammond of NYSDEC, dated August 8, 1991, transmitting information on the transition zone.

Letter from W. McCabe of EPA to S. Hammond of NYSDEC, dated August 20, 1991, confirming agreements reached on modeling aquifer restoration at the Site.

Letter from D. Markell of NYSDEC to W. Muszynski of EPA, dated May 6, 1992, regarding status of EPA's modeling of aquifer restoration at the Site.

Letter from K. Callahan of EPA to D. Markell of NYSDEC, dated June 11, 1992, describing progress on EPA's reevaluation of aquifer restoration at the Site since the April 1991 meeting between EPA and NYS, and upcoming schedule for completion of Brusseau modeling report.

Letter from K. Davis of NYSDEC to A. Hess of EPA, dated July 23, 1992, transmitting agenda items for July 30, 1992 meeting.

Letter from C. Petersen of EPA to S. Hammond of NYSDEC, dated September 8, 1992, summarizing July 30, 1992 meeting between technical representatives of NYSDEC and EPA on aquifer restoration at the Site.

Letter from L. Oliver, counsel for Town, to A. Hess of EPA, dated September 17, 1992, requesting information, pursuant to Freedom of Information Act, on Brusseau modeling of aquifer restoration of the Site.

Letter from R. Casson, consultant to Town, to A. Hess of EPA, dated September 25, 1992, requesting information outlined in Mr. Oliver's September 17, 1992 letter to EPA.

Letter from A. Hess of EPA to R. Casson, consultant to Town, dated September 30, 1992, responding to Mr. Casson's September 25, 1992 letter.

Letter from K. Davis of NYSDEC to C. Petersen of EPA, dated October 9, 1992, responding to EPA's September 8, 1992 letter.

Letter from K. Davis of NYSDEC to A. Hess of EPA and R. Casson (consultant to Town), undated (received October 21, 1992), presenting results of search for successful use in NYS of pump-and-treat method of aquifer restoration.

Letter from K. Davis of NYSDEC to A. Hess of EPA, dated October 20, 1992, regarding agreements reached for final (1993) modeling run of aquifer restoration at the Site.

Letter from S. Kivowitz of EPA to L. Oliver, counsel for Town, dated October 28, 1992 informing Mr. Oliver that EPA is preparing its response to his September 17, 1992 letter.

Letter from P. Hare of GE to A. Hess of EPA, dated November 10, 1992, regarding potential yield from a pumping well within the ground water plume at the Site.

Letter from D. Blazey, Regional Counsel of EPA, to L. Oliver, counsel for Town, dated November 30, 1992, containing EPA's response to Mr. Oliver's September 17, 1992 letter.

Letter from S. Kivowitz of EPA to M. Moore of NYS and L. Oliver, counsel for Town, dated November 30, 1992, transmitting draft stipulation and protective order for release of Brusseau model.

Letter from S. Kivowitz of EPA to Dr. Brusseau, dated November 30, 1992, transmitting draft stipulation and protective order for release of Brusseau model.

Letter from S. Kivowitz of EPA to S. McQuay, counsel for GE, dated December 1, 1992, transmitting draft stipulation and protective order for release of Brusseau model.

Letter from C. Petersen of EPA to R. Casson (consultant to Town), K. Davis of NYSDEC, and P. Hare of GE, dated December 14, 1992 summarizing October 5, 1992 meeting with Dr. Brusseau and technical representatives of NYSDEC, GE, the Town, and EPA.

Final Report by K. Davis of NYSDEC, dated December 29, 1992, entitled, "Inactive Hazardous Waste Disposal Site, Preliminary Site Evaluation, Phase 1, the Jamaica Road Area."

Letter from K. Davis of NYSDEC to A. Hess of EPA, dated February 4, 1993, transmitting NYSDEC correspondence on draft ATSDR Site Review and Update.

Letter from K. Davis of NYSDEC to A. Hess of EPA, dated February 10, 1993, transmitting report entitled, "Geotechnical Evaluation of the TM- Monitoring Wells situated between GE-Moreau Site and the Jamaica Road Area."

Letter from M. Gerstman of NYSDEC to D. Blazey of EPA, dated February 11, 1993, noting progress between EPA and NYSDEC technical staff on understanding of aquifer restoration at the Site and requesting that EPA take no further offical action until such time as Mr. Gerstman and Mr. Blazey have an opportunity to discuss this matter.

Letter from L. Oliver, counsel for Town, to A. Hess et al., dated March 8, 1993, responding to EPA's November 30, 1992 response to Mr. Oliver's September 17, 1992 request for information.

Letter from S. Kivowitz of EPA to L. Oliver, counsel for Town, dated May 13, 1993, responding to Mr. Oliver's March 8, 1993 letter and providing clarification of EPA's November 30, 1992 letter.

Letter from S. Kivowitz of EPA to L. Oliver, counsel for Town, dated July 12, 1993, transmitting output file for 1992 modeling of aquifer restoration at the Site.

Letter from W. McCabe of EPA to M. O'Toole of NYSDEC, dated July 15, 1993, transmitting G.E./Moreau reports, including EPA's July 6, 1993 modeling report, Army Corps of Engineers June 4, 1993 cost estimate for pulsed pumping remedy, and ATSDR's February 24, 1993 Site Review and Update.

Letter from C. Petersen of EPA to R. Casson (consultant to the Town) and P. Hare of GE, dated September 8, 1993, transmitting G.E./Moreau reports, including EPA's July 6, 1993 modeling report, Army Corps of Engineers June 4, 1993 cost estimate for pulsed pumping remedy, and ATSDR's February 24, 1993 Site Review and Update.

Fax from A. Hess of EPA to N. Briscoe of EPA-HQ, dated on or about September 27, 1993, transmitting, for HQ consultation, draft ESD for technical impracticability waiver of ground water clean-up standards at the Site.

Letter from W. McCabe of EPA to M. O'Toole of NYSDEC, dated September 29, 1993, requesting comment on enclosed draft documents: ESD for TI Waiver, ESD for Containment System Enhancement, Five-Year Review Report, and their respective public notices.

Memorandum from S. Mansbach of EPA-HQ to W. McCabe of EPA, dated October 4, 1993, confirming HQ consultation and supporting decision to waive ground water cleanup standards at the Site.

Letter from M. O'Toole of NYSDEC to W. McCabe of EPA, dated January 5, 1994, responding to EPA's July 15, 1993 letter and transmitting NYS comments on ESD for TI Waiver and Five-Year Review Report.

Letter from M. O'Toole of NYSDEC to W. McCabe of EPA, dated January 5, 1994, concurring with ESD for Containment System Enhancement.

Letter from G. Pavlou of EPA to M. O'Toole of NYSDEC, dated January 28, 1994, transmitting redline/strikeout versions of revised documents: ESD for TI Waiver, ESD for Containment System Enhancement, Five-Year Review Report, and their respective public notices.

Letter from M. O'Toole of NYSDEC to G. Pavlou of EPA, dated February 8, 1994, finding the revised documents in EPA's January 28, 1994 letter satisfactory and requesting that EPA proceed with publishing the public notices.

Fax from G. Pavlou of EPA to M. O'Toole and K. Davis of NYSDEC, dated February 23, 1994, transmitting revised language for introduction section of ESD.

Letter from M. O'Toole of NYSDEC to G. Pavlou of EPA, dated February 23, 1994, finding acceptable the revised language contained in EPA's fax of the same date.